

BRIGHTON AND SUSSEX
Medico - Chirurgical Society.

EXTRACT
FROM THE
REGULATIONS OF THE LIBRARY.

5. All books shall be returned half-yearly, on January 1 and July 1, that they may be inspected by the Committee.

6. Any member having had a book out in his name for a fortnight detaining it after it has been applied for by the Honorary Secretaries, shall be fined sixpence per day for each volume so detained.

7. Each member shall be held accountable for and shall make good any injury to or loss of any volume or series of volumes belonging to the Society while in his possession,

8. Any member who may notice an imperfection of any volume belonging to the Society is requested to make the same known to the Librarian,

29265/c

BRIGHTON AND SUSSEX
Medico - Chirurgical Society.

EXTRACT
FROM THE
REGULATIONS OF THE LIBRARY.

5. All books shall be returned half-yearly, on January 1 and July 1, that they may be inspected by the Committee.

6. Any member having had a book out in his name for a fortnight detaining it after it has been applied for by the Honorary Secretaries, shall be fined six-pence per day for each volume so detained.

7. Each member shall be held accountable for and shall make good any injury to or loss of any volume or series of volumes belonging to the Society while in his possession.

8. Any member who may notice an imperfection of any volume belonging to the Society is requested to make the same known to the Librarian.

*Smallman's Dictionary
Vol. 1058 (11th M.B.S.)
29*

*Lady Campbell
with the author's best respects*

(4)

THE
HUNTERIAN ORATION,

DELIVERED BEFORE

The Royal College of Surgeons

IN LONDON,

ON TUESDAY, FEBRUARY 14th, 1826,

BY SIR ANTHONY CARLISLE, K^T. F. R. S.

SURGEON EXTRAORDINARY TO HIS MAJESTY,
AND TO HIS ROYAL HIGHNESS THE DUKE OF GLOUCESTER;
SURGEON TO THE WESTMINSTER HOSPITAL, &c.

DEDICATED BY PERMISSION

TO

MR. SECRETARY PEEL.

LONDON:

PRINTED FOR JOHN BOOTH, DUKE STREET,
PORTLAND PLACE.

Price Seven Shillings.

1826.

HUNTERIAN ORATION,

The Royal College of Surgeons

IN LONDON,

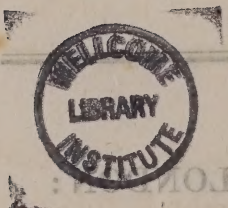
ON TUESDAY, FEBRUARY 14th, 1896,

BY SIR ANTHONY CARLISLE, Kt. F.R.S.

SURGEON EXTRAORDINARY TO HIS MAJESTY,
AND TO HIS ROYAL HIGHNESS THE DUKE OF GLOUCESTER;
SURGEON TO THE WESTMINSTER HOSPITAL, &c.

DEDICATED BY PERMISSION

MR. SECRETARY FEEL



PRINTED FOR JOHN BOOTH, DUKE STREET,

PORTLAND PLACE.

PRINTED BY WILLIAM NICOL,

Shakespeare Press,

CLEVELAND ROW, ST. JAMES'S.

TO

THE RIGHT HONOURABLE
ROBERT PEEL,
HIS MAJESTY'S
PRINCIPAL SECRETARY FOR THE HOME DEPARTMENT.

SIR,

THE Cultivators of Science have cause to rejoice that a Statesman has publicly acknowledged his obligations to the Writings of our greatest Philosopher, Lord BACON.—As the multitude are incapable of estimating the value of abstruse studies, and mediocrity is prone to oppose them, it has always been needful to solicit Patronage for the promotion of such researches.

To a Parliamentary Trustee of Mr. HUNTER's Collection, I most respectfully submit this attempt to extend it's usefulness, by an endeavour to connect some of the laws of inanimate matter with the more complicated operations of living bodies; my intention being to elucidate the nature of several animal processes, and gradually to introduce more

satisfactory views of the manner in which Medical remedies produce their effects.

To you, Sir, it may be suitable to know, that the Healing Art is daily acquiring greater certainty, from accessions of auxiliary Knowledge, and from the judicious introduction of discoveries in Physical Science; and, that the superior attainments of it's Practitioners are, by the liberality of their communications, extending so widely, as to promise in their progress an amelioration in Medicine to which no limit can reasonably be assigned.

I have the honour to subscribe myself,

With great respect,

SIR,

Your most obedient and humble Servant,

ANTHONY CARLISLE.

*Langham Place,
25th May, 1826.*

[2]

THE

HUNTERIAN ORATION.

HONOURED PRESIDENT,

THE TRANSCENDENT MERITS of JOHN HUNTER have been so often, so variously, and so eloquently represented in THIS THEATRE, that THE ANNIVERSARY of his Birth may, possibly, now be more beneficially celebrated by our endeavours to promote and complete his valuable Studies.

With this impression I shall venture to assume, that the Members of THE COLLEGE OF SURGEONS regard ANATOMY as the grand Source of MEDICAL KNOWLEDGE, and the HEALING ART as altogether *empirical*, unless it be founded on the Inductions of PHYSIOLOGY.

If the bodily construction of Man were simple, and each part obviously formed for a single purpose, it would be needless to examine the diversities of structure in other Creatures, in order to discover the purposes and functions of our animal Mechanism. In many instances, however, the Human organs are deeply obscured by complication in their tissues, connections, or composition,—for every par-

ticular Portion is more or less blended with vessels and parts not essential to it's special office, but appointed for subordinate uses, for union, and for communication with the living whole,—hence, then, it is often difficult to discern the affinity between the texture of the instrument and it's destined operations.

These perplexities have always beset the studies of Human Anatomy, and of Human Physiology,—but an additional obstruction accompanied the first steps of Medical Science among the Greeks, arising from Superstition,—for the Pagan Religion deemed the human likeness of it's Deities to be an hallowed subject, and only permitted this leading branch of Medical and Surgical Knowledge to be acquired through the medium of analogous Creatures, such as Apes.

On the restoration of useful Learning, and of intellectual Liberty, in the Fifteenth Century, the writings of the Classic Sages were eagerly and critically examined,—and in this zeal for information it was discovered, that the Anatomical descriptions of GALEN were unfit for Surgical guidance. Since that period, the knowledge of the Human mechanism has increased with the frequency of Dissections, and all English Surgeons are now expected to possess a more exact and complete acquaintance with the structure, position, and offices of every part of our Natural body, than was formerly known to the most celebrated Professors.

We may fairly congratulate our Brotherhood upon this creditable Progress, and upon the flattering hope of higher deserts, when the union of allied Sciences shall have rendered Surgery more rational, more safe, and more efficacious.

The operative Practice of Surgery is a mere mechanick art, when it is solely established upon a gross topical knowledge of Anatomy,—and if it be exercised with daring temerity, unchecked by moral or by scientific reflections, it becomes a desperate, if not a mischievous Profession.

A superficial knowledge of the Human body is sometimes imposed upon the Multitude, as an extraordinary attainment,—and when this assumption is further obtruded, by arrogating a superior degree of operative Skill, and an Infallibility which is not attainable, the vain Pretender, brandishing his knife over the terrified victims of his violence, may become a popular Surgeon, and by early good fortune he may force his way to vulgar fame, and wealth,—but his career is most dangerous, and the results are unenviable.

Young Surgeons, deluded by the evidences of practical Anatomy, are too apt to consider the transit from the dissecting to the operating Table, as a continuation of the same Scene. It is my duty, therefore, to state from long experience, that even a comprehensive and ready acquaintance with our natural Structure is an inadequate preparation for those vicissitudes, which diseased organizations, and casual displacements present in many operations. I am also free to confess, that I never yet performed, or assisted at a Surgical operation, which might not have been better done, if all the incidents could have been foreseen,—and, that I never witnessed an operation without some occurrence, which demanded the immediate judgement and moral courage of experienced thought, in addition to the views of Anatomy.

Young men have personal advantages, and when those

are cultivated by frequent attendance as Assistants, they may acquire the moral fortitude and presence of mind, which dangerous operations always demand.

The *superior* glory of Surgery depends upon the correction, or the cure of bodily infirmities, by scientific ministrations,—When those fail, and an incorrigible disease remains,—or, when an injury threatens the loss of life,—then the judicial sentence, which gives the Sufferer the choice of two dreadful evils, may be required,—and the arbiter of his fate must abide the consequences.

I am induced to dwell with more earnestness upon these cautionary remarks, from a conviction that a false confidence, arising out of Anatomical Pedantry, is very prevalent,—And, unless it be restrained, some of our Members may become liable to the severe, and, perhaps, the undeserved blame of legal Authorities.

A much safer, a more appropriate, and, ultimately, a more honourable Condition, awaits the Cultivators and the Improvers of the essential elements of Medical Science,—Nature having assigned no limits to the useful Discoveries, which the improvable Mind of Man has yet to make. The wide scope of general ZOOTOMY, commonly, but improperly termed “*Comparative Anatomy*,” is open to diligence, genius, and youthful ambition,—and, THE HUNTERIAN COLLECTION displays examples both of curious isolated facts, and of Physiological series, sufficiently apposite for it's useful extension.

SURGERY claims the designation of a SCIENCE, from several antient and modern Charters specially granted to THIS COLLEGE,—and the Gentlemen appointed to deliver

THE HUNTERIAN ORATION, are particularly called upon to support that just distinction. But, if any person should question the practical uses of such refinement, we are ready to show it's value, by pointing out the enlarged Capacity and the superior Tact of Scientific men.

Intellectual cultivation, by exciting more than ordinary attention, produces an exact and circumstantial vision, far beyond that which is purely natural,—and manual skill is increased by a true confidence of the mind, when it arises from expanded judgement,—the Mind and the Hand being alike capable of nearer approaches to mathematical precision, from scientific exercise.

To neglect, or to undervalue these important considerations,—or, to deny the necessity for Scientific Skill and Moral Judgement in our terrible Duties, would be basely disgraceful to our Profession, and injurious to Humanity. We are individually answerable for all the consequences of our Advice and Works,—and we should compromise the safety of the Afflicted, and betray the rights of our Station, by unworthy Submission to any other Authority. The Qualifications for determining the Propriety of our dangerous duties belong, of necessity, to Persons expressly educated to judge of their expediency or moral fitness,—and we cannot honestly, or with advantage to the Public, either delegate or divide our Responsibilities. The pretensions of modern English Surgeons to the entire control of their own Practice, rest upon a superior knowledge of Human Anatomy,—and the honoured labours of Mr. HUNTER have *introduced* the genuine elements of organic Physiology.

From the precious remains of the Writings of ARISTOTLE

it appears, that he deemed the Anatomical Analysis of the whole Living Creation to be the only way to obtain rational views of the Laws of Animal Nature,—and Lord BACON, Dr. HARVEY, Baron HALLER, and our HUNTER, entertaining similarly enlarged sentiments, have since rivetted the attention of Medical Philosophers to that subject,—and they have shown, that circumstantial, minute, and particular details of facts must precede all rational inductions. Those great Men, observing the Complex structure of the Human body, and the occasional Singleness of texture in many simple Animals, wisely sought to reveal the obscurities of Human Anatomy, by inspecting the detached parts of organic mechanism, in an unravelled state as they often occur, in more humble Creatures.

In the present age, all Naturalists have adopted a similar course of Generalization,—and, although our Countrymen have lately been surpassed in neighbouring Nations, as to the Systematic arrangements of ZOOLOGY and ZOOTOMY,—yet, I trust, we stand unequalled in the Practical applications of Natural Knowledge to the duties of our Faculty.

The several distinguishing Characters, and the numerous Affinities visible among the Creatures of this Orb, are not always essentially connected with Physiological views of their inward structure, but they afford to the Zoological Naturalist and to Scholars the means for classing and naming a multitude of distinct objects, without which our Anatomical records would be unintelligible. Hence it is, that the knowledge of ZOOLOGY and of ZOOTOMY is inseparable,—for, like MINERALOGY and CHYMISTRY, they reciprocally support each other. The advancement and the diffusion of organic

Physiology depend upon the general adoption of an exact and permanent Language, whose descriptive definitions shall circumscribe and denote every Species of Living form.

This desirable consummation may, perhaps, be regarded as not far distant, when we estimate the liberal assistance of Learned Men,—the improved Accesses to useful Knowledge,—and the increasing Intelligence of Mankind. Whenever such stability of Nomenclature shall arrive, Scholars will have less cause to lament those Losses to Literature and Science, which have followed the Destruction of Antient Manuscripts,—or, to regret the difficulties which now attend the meaning of obscure or abstruse passages, hitherto ill understood from the verbal remains of Classic pages.

The Physical Sciences are now rapidly dispelling the unworthy mysteries of the Healing Art. And we may soon expect the Doctrines of PHYSIOLOGY, of PATHOLOGY, and of SURGICAL THERAPEUTICS, to be established upon the clear evidences of Anatomical Structure, and of Chymical agencies,—neither of them singly being adequate to explain the workings of Life, the errors of Disease, or the manner in which our Remedies become efficacious.

I will now submit, as suitable to this occasion, a specimen of Natural History and of Zootomy, which is far removed in it's character from the organic constitution of Man,—and, yet, I hope to trace it's practical applications to the Healing Art,—confidently relying upon this belief, that, to those who understand the Philosophical purposes of THE HUNTERIAN COLLECTION, it will be superfluous to urge any excuse for this deviation from the routine of former Eulogies.

My first design embraced a review of all the recorded Incidents, connected with the selected Object,—but I found the undertaking would extend beyond the limits of a single Discourse, and that it would introduce many irrelevant Topics. I have, therefore, decided to abandon several parts of the Zoological History, and to direct my observations to some facts in Zootomy, and in Chymistry, which promise to extend the Sciences of organic Physiology, of Pathology, and of Surgical Therapeutics.

The Creature which I have fixed upon, as an example for comparison in the succeeding Treatise, is the common eatable OYSTER,—an Animal, which to passive observers presents nothing remarkable, or, it may be thought, is sufficiently known,—but to my judgement, the various facts of it's structure and many of it's detached offices are analogous to several occurrences in the Human body,—while those simple indications of Nature tend to illustrate and to declare some of the more elaborate and obscure operations of Health, of Disease, and of our remedial Art. It will, however, be obvious that the shortness of my time must limit this analytical exposition, to a few leading particulars respecting the Anatomy and the Physiology of the OYSTER,—and I am satisfied that I shall receive your indulgence, for the apparent inconsistency of mingling general assumptions with especial details.

Our English proper name OYSTER,—as well as the antient Saxon, *Ostre*, and *Ostra*,—are obviously borrowed from the Greek and Roman words, ὀστρεον, and *Ostreum*, which appear to have been given to these Shells, because of their resemblance in several properties to *Bones*;

—for the Classic terms, 'ΟΣΤΕΟΝ, and *Os*, (*ossis*), were probably first imposed, because *Bones* would attract earlier notice than *Shells*; and words of similar sounds would afterwards become eligible to denote analogous objects;—such coincidence among substantives being in the natural order of human thought, and, consequently, of frequent occurrence.

In all the modern Languages of Europe the Classic root prevails, and it has been invariably used by Naturalists,—hence it would be superfluous to cite the *synonyms* of the Oyster.

The Russian, *Ustreetsa*,—the Armenian, *Ostrighe*,—the Persian, *Istiridia*,—and the Hindustanee, *Kustoora*, are kindred sounds. Arabic and Hebrew names for the Oyster bear no affinity to those of Classic origin,—neither do the appellatives of the Chinese, who use three differently sounding words, to denote a large, a small, and a round Oyster.

Modern Zoologists derive their distinctions and descriptive definitions of Creatures of this kind from their Shells; for a numerous tribe of soft-bodied Animals, which are denominated *Mollusca*, are protected by earthy Shells, and they are arranged together under the Title of *Mollusca testacea*, to separate them from another Series of similar Animals which are without Shells, and consequently termed *Mollusca nuda*.

A subordinate division of the *Testacea* collects together those which possess two shells, and such are termed *Bivalves*. Under this denomination the Oyster forms a Genus or Family, comprising many distinct sorts, called *Species*;

—and, in the tables of Classification, the species to be hereafter described, is termed “*Edulis*.”

The leading features of the Shells, or those parts of them which are common to every species of Oyster, have been employed by Naturalists to define the Genus, while particular characteristics have served to discriminate the Species. The neat technical method of LINNEUS has been improved by LAMARCK, but his descriptive definitions are still unsatisfactory, and, in some instances, incorrect;—as it appears in the following account of the genus *Ostrea*.

“Testa foliacea, irregularis, inequivalvis; Umbonibus subdivaricatis, ætate inæqualissimis. Valva inferior major, concava, *adhærens*; superior minor, planiuscula. Cardo edentulus. Ligamentum semiinternum, disco sub trigono, tripartito, in utrâque valvâ affixum. Impressiones musculares in utraque valva *duæ*, altera magna, suborbicularis, subcentralis; *altera* minutissima, infra cardinem *posita*.”

It is to be regretted that many undefined technical words are here presented to the general reader,—such as the *umbones* or *knobs* above and below the hinge, the *dentes* or *tooth-like* projections, and the *discs*, or spaces to which the hinge ligament is affixed. Also, in this short description many errors appear,—viz. 1st. The inferior valve is not always *adhering* to some other body;—2d. The hinge does exhibit *denticulated processes* on the sides of the discs;—and, 3d. There is not any other *muscular attachment* to the shells, than that of their central parts.

The species of Oyster, termed “*Edulis*,” is thus insufficiently defined—

“ Testa ovato-retundata, foliacea, squamosa; valva superiore minore, planata; margine interno integerrimo.”

Each of these distinctive marks are so liable to change, and thence to form individual varieties, that it is difficult to establish any brief specific description of the *Ostrea edulis*; —for every bay, estuary, harbour, or space in the sea has it's local vicissitudes, as to the supplies of food, depth of water, currents, tides, or other influential causes; and these manifestly affect the figure or thickness of the shells of this species of Oyster:—Organic varieties appear to be natural compliances, adapted to accommodate individuals when their proper habitudes are disturbed; and such deviations occur alike to Animals and to Plants, causing differences which are too often regarded as distinct species.

Persons not versed in modern Zoology might hastily conclude, that the genus *Ostrea* is now exactly determined, and the boundaries of it's species finally settled; but Nature presents so many delusive *semblances* among creatures of *different* kinds, and occasionally adds such *incongruous* features to members of the *same* family, that the task of assortment is extremely difficult. Artificial systems of classification being only generalizations of those objects, which approach nearest to each other in their forms and constitution.

The ordinations of Infinite power are not, however, limited to any series within the scope of human arrangement; but they extend into endless diversity, — each species being appointed to it's allotted share of existence, and to promote the harmonious maintenance of the whole Creation.—Thus it happens, that the substances and the creatures of this

globe are severally designed for their respective stations, and each of them made to subsist under the general dominion of physical laws,—occasioning many reciprocities between animals, vegetables, and minerals; for the unceasing operations of Nature are every where engaged in converting the elementary materials set free by dissolution, into new compounds, or into rising generations.

Under the powerful sway of the Seasons, and of other general concurring influences, the smaller destinies of Nature are assured: Vegetables being the purveyors to Animals, by drinking up gross solutions of decaying mortuary remains, mingled with liquid minerals; and thus re-elaborating the food of Animals from the crude elements of the three Kingdoms. Each organized *Automaton* is imbued with a power to model itself after the fashion of it's species, to continue it's vital term, and to reproduce it's kind; after which it's bodily materials are ordained to pass back again through incalculable revolutions.

The sublime and mathematically proved theories of the Coelestial bodies encourage our researches into the *more* concealed operations of Life,—for if we estimate the possible elevation of our Science, by the divine advances in Astronomy, we may justly expect that the Art of Healing will attain to degrees of precision and power, in future ages, which it would now be rash to conjecture.

Many kinds of Testaceous animals have existed in those early stages of the Creation which were antecedent to the human race, and among organic fossils the shells of Oysters are often found in situations far removed from the present levels of neighbouring Seas. Every distinct *species*

of living Testaceous *animal* possesses some characteristic structure corresponding with the peculiar forms of it's shells; and the several species of Oysters are subject to all those deviations; but Anatomists have not yet collated such minute distinctions in any of the lower classes. By the united systems of Arrangement and of Nomenclature, now adopted among Zoologists and Zootomists, the animal which inhabits the shells of the Oyster, is placed in a Tribe denominated "*Acephala*;" that being one of six subdivisions, given to the Testaceous *Mollusca*.

The body of the Oyster is without a head; and it has no *distinct* limb analogous to that of the Cockle and Muscle, which is called a *Foot*. Not having any especial organs for seeing, hearing, or smelling, the creature is limited to perceive no other impressions but those of immediate contact: and yet every part of it's exterior seems to be sensible to light, sounds, odours, and liquid stimulants, in consequence of the privation of cuticle.

It is asserted by the Fishermen, that Oysters in confined beds, may be seen, if the water is clear, *to close their shells*, whenever the shadow of a boat passes over them.

The shelly case of the Oyster is it's sole security,—and a superior delicacy of touch, diffused over the whole of the living surfaces, warns the creature of every danger, and bids the closing of the senseless valves.

The inward organization is equally simple with the exterior forms, and both are suited to a passive life; for, *locomotive* beings demand evidences of distant things,—sometimes to supply their wants, and on other occasions to inform them of danger;—but a stationary creature, being

doomed to rely on it's fixed resources, would only be tantalized by evidences placed beyond it's control.

The Oyster animal is attached to it's shells by a very conspicuous mass of muscle and tendinous ligament, which adheres to the centres of the insides of the shells; and around this middle substance, all the other living parts are affixed. Between the muscular ligament and the hinge of the shells, the chief bulk of the body is situate; it occupies the great concavity of the under valve, presenting a squared margin opposite to the hinge, and a projecting margin along it's two sides,—the surfaces of the body which are placed in contact with the shells, present a lacework of fat, when the animal is in good condition, resembling that of the *omentum* in quadrupeds. The marginal borders, proceeding alike from the upper and the under surfaces of the body, are gradually extended as they advance toward the edges of the shells,—and they form the outline of those expanded membranes, called the *Pallium* or *Coverlet*, which occupy the flatted and larger portions of the shells, and fold over the water lungs, termed *Branchiæ* or *Gills*.

As there are some parts of the animal, and of it's shells, which differ on the two sides or borders, it becomes necessary to define a *right* and a *left side*. If an Oyster be placed with it's concave shell downward, and having the hinge next to the observer, the right and left sides will be then determined. The loose folds of the *Pallium* become united on the right side, nearly opposite to the muscular ligament,—and they form an entrance to the interior of the *Branchiæ*, which may be named the *Branchial Porch*. When the shells are expanded, the cavity of the Branchial

tube becomes necessarily dilated, and this occasions a rush of water into all the internal proper Branchial vessels,—while the outer surfaces of those gills are floated in fresh supplies of water at each opening and closing of the shells. This simple and effective mechanism of these water bellows is like the other all-wise providings of Omnipotence.

At the upper squared end of the body, the marginal borders appear to be glandular,—and these, together with a middle follicle, seem appointed to form the elastic ligament or spring of the hinge. The two angles of this end of the Oyster are slightly attached to both the upper and under shells, by the upper and under surfaces of these angular extremities; but those adhesions are not muscular,—they are merely close contacts, and only occasionally used to make the glandular parts touch the elastic ligament of the hinge.

At the upper end of the body and on it's left side, the marginal borders are more extended than upon the opposite or right side,—and the top of this border forms a hood over the mouth, where two pairs of leaf-like lips are placed, so as to direct the casually presented food into the throat. The marginal borders on the left sides descend to form the *Pallium*, and they meet and coalesce with those from the right sides at the *Branchial porch*. In the middle, between the folds of the pallium on the right side, and in contact with the central muscle, the terminal intestine descends,—and it's opening or anus is situate at the entrance of the Branchial porch.

The Branchiæ or proper gills consist of four equal sized folds inclosed by the pallium. These Branchiæ extend from

between the palpi or lips of the mouth, on the left side, to the junctions of the pallium, on the right side, where it forms the Branchial Porch. The roots of these gills are joined to the insertions of the pallium, where it's two folds adhere to the central tendon,—and by this structure a large branchial cavity is formed, into which the smaller branchial tubes open by four distinct rows of holes, each of them allotted to one plait of the gills. When any liquid is forced into the branchial cavity, it spirts out at numerous distinct pores along the convex edges of the gills, and these pores severally correspond with the single tubes assigned to each plait of the Branchiæ,—so that the inspired water passes from the branchial cavity straight through the tubes of the gills into the open space between the folds of the pallium, without returning.

This water respiration is probably a chymical action upon the elements of the water itself, and not an abstraction of air,—because Oysters, and such like animals, often reside at extreme depths in the sea, where the pressure upon gaseous matter would be a physical obstacle.

The *Heart* of the Oyster is seated within a free space, which is bounded by an arch of the body formed between the great valvular muscle and the mass which is occupied by the liver and stomach. Two remarkable circumstances belong to this heart:—it's contained fluid, or blood, does not coagulate spontaneously,—and it holds in solution the same proportion of sea salt with the surrounding water. The muscular flesh of the ventricle of the heart is soft and tender, like that of an incubated chick in it's first stage. The auricles are of a black colour throughout their tissue,—

a peculiarity not easy to be explained. The arterial and venous systems resemble those of the whole tribe of molluscs *Acephala*; but the singularities of each species are difficult to be traced, because the vessels are too delicate to admit gross injections, and those of more refined composition are apt to pass out of the vascular tubes, and by extravasations to spoil their distinctness.

Within the body, are the Stomach and Liver, occupying it's principal bulk. The Stomach consists of a sinuous cavity, subdivided by alternate projections and clefts adapted to each other,—and in those spaces I have generally found a detached piece of cartilage, whose office may be that of assisting in the trituration of the food, because the interior of the Stomach itself presents similar cartilaginous projections.

The Intestine is a simple tube coiled round the Stomach and the Liver,—it begins at the lower and left end of the Stomach, and terminates at the Branchial porch,—it is tinged with umber-coloured bile throughout it's course.

The Liver is the most conspicuous, and the largest of all the glandular organs assigned to this tribe of animals,—it every where surrounds the Stomach, and by obvious pores discharges it's bile into every space of that cavity, colouring the contents of an umber brown hue. Externally, the Liver exhibits a regular series of equal sized granules, which may be shown by boiling the animal, and then tearing off it's loosened exterior covering. The inward structure presents arborescent vessels, which converge into the excretory ducts as they approach the Stomach.—It is worthy of notice, that the minute vessels of the Liver, in all these creatures,

assume an *acinated* or *grape-like* figure, similar to that which is common to all the higher orders of animals.

Both the surface of the animal in contact with the concave, and that in contact with the flat shell, present similar parts,—and the cavity for lodging the heart is equally exposed to the inner surface of each shell.

A cone-shaped extension of the body winds along the left side of the muscular ligament,—it has a tubular cavity, which communicates with the alimentary passages,—it resembles the reproductive parts in the Scollop, and is an obscure likeness of the *Foot* in some other *Acephala*.

Oysters are considered to be perfectly androgynous; but it is questionable, whether any animal possesses the capability of impregnating itself,—because, in all the known instances of hermaphrodites, such as those of earth worms and garden snails, the mutual intercourse of two individuals is required, notwithstanding the equal possession of both male and female organs by each. Throughout the animal and vegetable kingdoms, the sexual appointments are *obviously* intended to insure the crossing of breeds, in order to *check* the propagation of varieties, which are always growing encroachments upon the standard models of species; indeed, the breeding among near kindred soon terminates any particular race, by inducing such deviations from the essential structure of the creature as must stop the continuance of that line.

Sexual crossings from different individuals (perhaps each of them inclined to deviate into opposite varieties,) are the natural means for preserving the right line of definite species,—and the offspring of creatures destitute of locomotion

may be presumed to share in that protection, although animals possessed of the greatest complexity of parts are necessarily liable to the most numerous alterations.

Oysters are viviparous,—and their young are found within the Tracheal passages, and between the folds of the Coverlet, during the months of June and July, in this climate. In it's first state, the Oyster exhibits two semiorbicular films of transparent shell, which are continually opening and closing at regular intervals. The whole brood are associated together, by being involved in a viscid slime, and in that state called, “*The Spat.*”—It being common among viviparous animals of this kind to have their spawn posited in contact with the lungs, the involving slime serves as the first nutriment,—and we may infer, that the foetal food, so influenced by the Gills, is at the same time a respiratory supply to the imperfectly formed young.

The *Brain*, or substance principally concerned with sensibility, is small in proportion to the bulk of an Oyster. It consists of two minute detached nodules or ganglions, each having a few slender nervous fibrils passing in radii to the neighbouring parts; the largest ganglion is affixed to the gullet,—showing, that the chief self-preserving sense is given to test the articles of food.

The terminal extremities of all the nerves are inconspicuous, from gradually losing their distinguishing opacity, and from blending their brainy substance with other parts, as they recede from the ganglions.

A similar termination happens to all the nerves of the Human body, with the exception of the Optic and the proper Auditory nerves, whose final distribution, in their

respective organs, is a web of brain,—this being an ordination for receiving miniature impressions of complicated distant phænomena, through those microscopes and microphones of the mind, the *Eye* and the *Ear*.

At some future time, the comparative analogies of the brains and nerves, in different classes of animals, may be subjected to a copious analysis, and an estimate formed of the number and kinds of sensations allotted to the different grades of intellect. Such a method of comparative Psychology was begun by the learned and pious Dr. THOMAS WILLIS, one of the Founders of The Royal Society of London. His Anatomical Treatise on the Souls of Brutes was dedicated to GILBERT SHELDON, then Archbishop of Canterbury, after having been read as THE SEDLEAN LECTURE, and printed at Oxford, in 1672.

The body of the Oyster is entirely covered by one continuous membrane, which extends to the margins of the pallium, and embraces within it's folds all the vessels and parts belonging to that apparatus. Several transparent arborescing blood-vessels are placed between this outer membrane and the substances of the body, and on the palpi or lips,—these being visible to the unaided eye, from their contiguity with the opaque fat.

The most satisfactory process for obtaining animal oils or fat from their states of combination with other animal substances, is,—First, to coagulate the mass, if a solid, in boiling water,—and, if a liquid, to evaporate the water,—then bruise the pulp, and allow it to digest in sulphuric ether; decant the solution, and permit the ether to evaporate at the atmospheric temperature in a shallow glass

vessel, when the oil or fat will remain. In this manner I have obtained all the colouring materials from the yolk of a bird's egg, from the red flesh of salmon, and from the ova and colouring of the shells of lobsters,—each of them consisting of fat oil, in which the colouring matter is dissolved. In a similar way I have been successful in obtaining the colour from many other animal substances, and from several kinds of vegetables; for by first coagulating the albuminous and extractive parts, the menstruum of ether detaches all the oils and resins which are so generally combined with the dense particles of colourization. If, however, the chymical experimenter, after having obtained these coloured compounds, should next proceed to deflagrate or burn them, he will lose the object of his pursuit,—for the flame of combustion carries away all finely comminuted particles, even to those of the metals and earths,—and watery vaporizations or distillations, contrary to vulgar opinion, have similar capabilities,—this being evinced by a smell of brass when it is moistened, and by the earthy effluvia from wetted clay and chalk when recently employed in cleaning a stone staircase. The most eligible process for separating the colours in question is, to decompose the oily compound by nitric acid, and then to search for the residuary elements in the nitric solution.

The marginal borders of the Pallium are not attached to the shells, but they occupy the whole range of their inner circumferences, and are moveable towards the edges of the shells or retractable at discretion. Two arrangements of muscle appear along the loose borders of the pallium: one set of muscular fibres forms a longitudinal band of several lines

in breadth, and this serves to gather up and shorten the outline of the pallium, when it is retracted,—the other is a series of muscles passing from the margin in radii toward the central or great muscular ligament. The muscular parts of these radiated muscles extend a few lines within those of the longitudinal bands; they are obviously retractors, or opponents to the marginal protrusions of the pallium,—and each bundle of their muscles is attached to a small tendon. These tendons form a lace-work by lateral junctions with each other, until the whole are collected into two principal cords, which are converged together, and finally inserted into the left sides of the central muscular ligament. This plexus of tendons resembles that of the extensors of the human Fingers,—but their subdivisions in the Oyster consist of several series, and those which are joined to the muscles are exceedingly multiplied. From observing the living Oyster, it is evident that these radiated muscles are excited to contract when touched, and that each stimulated part hauls up a tuck of the border of the pallium,—and by a continuity with adjacent tendons, every touched point moves and excites similar neighbouring and allied muscles, so as to withdraw a larger portion of the pallium from annoyance.

The use of all these arrangements appears to be for the protection of the living animal,—since the irritable muscular borders of the pallium are not only adapted to withdraw *themselves* from hurtful impressions, but by pulling the associated tendons against the central muscle, *it* becomes likewise excited, and immediately closes the valves.

Along the borders of each fold of the Pallium, and pro-

jecting from both edges of their margins, are two rows of *Papillæ*, which are sometimes to be seen distended with water, and at other times they are collapsed into a fringe-like substance. In the distended state, these papillæ, or nipples, often eject water from a pore at the point of each, and then collapse.

The *Mesenterick portions* of the pallium are fixed to the central muscle and tendon; they each consist of two plates of the general investing membrane, and they embrace the tendons of the radiated marginal muscles. Between these membranous plates there are non-adhering spaces, like those between the *pia* and *dura maters* of the Human brain, and from being occasionally found distended with water, they have been, as *I believe*, falsely called "*Absorbing Vessels*." These spaces appear to be truly cellular, and not continuous tubes,—for they communicate with each other laterally, and thus resemble the tubular cells of the *corpus spongiosum penis*, just before they are converted into veins.

The use of the cellular structure of these mesenterick membranes is, to protrude the margins of the pallium by the force and direction of injected water,—for, when the mesentery of the pallium is so distended, the fringed borders are pushed to the margins of the shells. This action is more directly manifested in the syphon of the *Pholas dactylis*. A dingy green colouring matter appears irregularly dispersed through the larger convex ranges of the *fimbriæ*,—and it appears to be the same as the tinging substance of the scales belonging to the upper or flat shell.

Papillæ, exactly similar to those of the Oyster, may be seen in the syphons of *Pholades*, in the *fresh-water Muscle*,

in *Actiniæ*, and in several other *Mollusca*. The outer surfaces of the pallium are occasionally found adhering, at uncertain places, to the insides of the shells,—but this cohesion depends wholly upon close contact,—and it only happens where the shell is undergoing repair, or where it is augmenting: in no instance does the substance of the pallium mingle with the shelly materials.

Having now adduced the general facts which Anatomy discovers in the OYSTER, and also a selection from the particulars exhibited in the structure of the *Coverlet*, I proceed to show the kind of connection subsisting between the living animal and it's earthy case or shells.

From the first state of existence as a pair of semiorbicular minute shells, onward to it's final growth, the Oyster has no other fixed connection with it's two shells except that of a central defined oval surface in each valve, where the great closing muscle and an accompanying tendinous ligament are attached.

During every stage of the growth of the Oyster, an exact fitting of parts is maintained between the living animal and it's exuvial shells. The progress of growing is always from those points of the hinge, which had constituted the original pair of foetal valves,—and, in each succeeding augmentation, the great valvular muscle and it's ligament are constantly placed in the centres of the shells,—so that each advance from the hinge necessarily removes this muscle and ligament straight forward, causing them to quit their former seats of adhesion, and leaving the vacated impressions to be covered and obliterated by succeeding deposited plates of shell. At no period is there any trace of vascular, fibrous,

or membranous continuity between the parts of this muscle or ligament and the substances of the shells; and if the calcareous matter of an entire Oyster be dissolved in a sufficiently diluted acid, the animal structures of the valvular muscle and ligament continue unaltered,—but their junctions with the shells are entirely detached, and not a single fibre or shred of membrane remains in continuity with the testaceous parts.

The valves are bound together at the hinge by a peculiar springy substance, termed “*Elastic ligament*,”—and it’s elasticity is limited to a moderate degree of re-action or expansion after any compressing force is removed. This elastic substance is not extensile, like the India elastic gum,—for it’s cohesion is broken by attempting to draw it out beyond it’s passive limits. It does not hold any continuity with either the materials of the shells, or with the living structures of the animal,—and it becomes wholly detached from the discs, when the shells have been steeped in a weak acid.

This springy ligament of the Oyster is of a wedge shape, having it’s thickest part inward. It consists of three portions, fitted to the three triangular partitions in the discs: the middle portion is of equal thickness on it’s inward aspect, and it is there of a semi-pellucid, iridescent green and yellow hue,—as the wedge passes outward, and toward the points of the hinge, it becomes darker coloured, less pellucid, and gradually presents more of decay, until,—finally, the parts in contact with the sea water consist of an inky black mud.*

* It may be of future use to note, that the natural decomposition of dead shell fish is, first into a black pulp, which stains their shells,—and afterwards,

The two side portions of the spring are thinned off toward their edges,—they are continuous with the inner films of the valves,—and they appear to possess some of the properties of a binding ligament, similar to that of the hinge in the Scollop, and in many other bivalves.

When the springy ligament is broken or torn by extension, or if suffered to dry and crack, it divides into rectangular portions, which are fibrous in their perpendicular directions.

The elasticity of this substance is not materially affected by boiling in water,—and it is not soluble in alcohol, in ether, or in oil of turpentine,—but it dissolves in liquid potash. In the fire it softens, swells into bubbles, and yields an inflammable gas, of a peculiar smell: it appears to consist of albumen, mingled with oil,—and it is nearly free from the calcareous matter of shell.

The elastic ligaments of bivalves partake of the properties of cartilage, and of horn in quadrupeds,—an excess of oil is perhaps given to resist the action of water, seeing that they do not possess the vascular regenerating supplies of living structures,—and the mechanical disposition of the materials depends upon their manner of deposit.

The testaceous coverings of different animals are various in their composition, structure, and appearance. Some of them consist entirely of a dull opaque earthy substance, possessing but a small proportion of animal matter,—others are semi-transparent, and finely laminated with films of

at a distant time, the stains assume an ochry red colour. These facts are remarkably observable in the different stages of decomposition of the *Pholas dactylis*, when deeply imbedded in chalk rocks.

albumen, constituting *Naker*, or *Mother of Pearl*. Many shells are partly constructed of half crystallized *Lime* and of *Naker*,—while others exhibit epidermoid coverings, or semi-epidermoid scales, with occasional patches of carbonate of lime, free from animal matter. These several diversities of composition and structure are not limited to one kind of shells, but they extend through the univalves, bivalves, and multivalves,—and the eatable Oyster presents an instance of all those vicissitudes.

In order to establish some physiological inductions, which are the principal intent of this Discourse, it is essential, first, to show an unquestionable distinction between animal structures that are constantly maintained by vessels which bring renovating supplies from the living system, and those extraneous deposits which are either wholly detached from the vascular and sensitive parts, or only hold partial communications with them.

The coexistence of living substances, which are continually changing their materials,—with fixed deposits, not pervaded by vessels, or endowed with sensibility,—is common to the whole organized creation; and as the Physiological and Pathological considerations of this subject lead to many important practical views in the Healing Art, I shall now request your patient attention to some minute incidents, respecting the formation of the *Shells* of the OYSTER.

All the solid parts of living bodies have been previously held in solution by their nutritious fluids,—and the liquid state of those elementary materials depends upon water. In the digestion of food, it does not seem that the constituent elements of water are disturbed,—and many other materials

pass from the stomachs of animals into their circulating vessels without suffering any change, such as muriate of Soda, the colouring part of Rhubarb, &c. But, in the secretory productions of vegetable essential oils, it is probable that *Hydrogen* is detached, and it's former associate, *Oxygen*, enters into new combinations.

The proportions of water to the dissolved materials in the juices of plants, and in the blood of animals, are continually varying,—so that the condition of the fluid elements of living creatures is neither exactly defined, nor the same at different times; but all the crude materials for growth, renovation, or repair, are invariably presented at the required points, in a state of watery solution; while the selection of especial matter, it's new combinations, or changes of composition, depend on vital and other agencies, which are not sufficiently understood.

In the present state of Anatomical knowledge, it might prove an useful distinction, to name those parts of animals which have no continuity by vessels with the unquestionable living structures, *Extra-vascular*, or *Extra-vital deposits*; and we are justified in making this division, by observing crystallized carbonates and phosphates of lime as constituent substances in shells, bones, and teeth.

These mineral compounds, as well as various kinds of exuvial productions, made for the defence of living and sensitive parts, are shut out from the self-modelling organization of vascular and sensitive structures. Some extra-vital parts retain a limited intercourse with blood vessels at the surfaces of their growth,—and this occurs to the roots and under surfaces of the Human Nails, and to the Hoofs

of Cattle. The roots or attachments of hairs, spines, scales, cuticle, and feathers, are similarly circumstanced,—only that hairs, spines, cuticle, and feathers are periodically cast off, and replaced by new successions,—while nails, scales,* and hoofs are permanent, and their worn or damaged surfaces are replaced by fresh advances of substance, in which the living vessels are gradually obliterated as the parts proceed to become external.

The tusks of the Elephant, and the cutting teeth of the Beaver, Squirrel, and other *Rodentia*, which are destined to wear away, resemble our nails; for they are organized, and grow from their roots,—but lose both vascularity and sensibility at their exposed surfaces. The shells of the Crab tribes, termed “*Crustacea*,” are periodically cast off, to accommodate the creature to successive augmentations of its bulk.

From the water, which gives fluidity to all the elementary materials of animals and vegetables, up to the substances of the human brain, there are evidences of partial vitality, constituting mixtures of organic matter with inorganic,—and until these are severally and exactly distinguished, we cannot fix upon the natural causes, or the agencies under which each compound is formed or maintained.

Having assumed that Shells are altogether destitute of

* The distinct pieces of horny shell in Tortoises are augmented while the animal is growing, by a succession of white lines around the margin of each,—and these new growths are at first soft, like cheese curd; they continue to be highly sensible to the touch for many days, and then gradually assume the hardness, colour, and insensibility of the older shell. Human nails, the hoofs and claws of animals, and the scales of fishes, are formed in a similar manner.

vascular connection with the living animal, and consequently insensible and incapable of self repair,—it becomes fit to adduce the proofs of their extra-vital condition.

The shells of Oysters present three different substances, in more or less detached states,—and, in many instances, all the three substances are blended together. The first distinct kind of substance is purely *Animal*, and it occurs in the form of thin membranes or films, whose structure is neither fibrous nor reticular; whereas the vascular and vital membranes of animals are invariably fibrous. These testaceous membranes are insoluble in boiling water,—contrary to the animal portion of bones yielding glue; but from the former possessing many properties analogous to the White of an Egg, it is termed, by modern chymists, “*Albumen.*”

It must be understood, that I do not insist upon the exactness of chymical statements respecting the composition of Animal or Vegetable substances, because small portions of both Gelatine and of Albumen are often mingled with excesses of each other,—and the same want of absolute distinctness occurs among the Carbonates and Phosphates of Lime. General results, however, fix the limits of our imperfect researches,—while universals remain the attribute of Infinity.

Carbonate of Lime is the next constituent of Shells,—and when this mineral compound is minutely interspersed among the purer films, it forms *Naker*, or *Mother of Pearl*. The baubles, called “*Pearls*,” consist of concentric layers of these two substances, alternately deposited upon a rounded extraneous nucleus,—and the animals which produce them, may be induced artificially to make Pearls of any desired form or size.

The shells of different kinds of testaceous animals exhibit various proportions of mixture between the *animal* membranes and the *calcareous* deposits,—affording to some an entire pearly appearance, and to others a marble or stone-like condition.

The shells of the *Chama gigas* have no pearly structure, and, they have an equal density with *Carara* marble,—suffering a similar fracture, and bearing an equal polish.

When the growth of shells proceeds wholly from their margins, without any augmentation in their thickness, as happens in the *Paper Nautilus*, and in the *Pholas dactylis*, there is none of that alternate lamination which constitutes *Mother of Pearl*.

Many shells have a temporary or a local epidermis, thrown out as a defence to the soft elaborating parts, while they form the shell; and along the margin of the flat valve in the Oyster, this epidermoid production consists of a mixture of albumen and of carbonate of lime, coloured like the fimbriæ of the pallium. While moist, these epidermoid shelving scales are elastic,—but when dry, they are brittle; showing that the property of flexibility in them depends upon a temporary softening of the albumen, unconnected with the living functions. The squamous projections of the under or concave valve are not at all flexible.

After having devoted many years to the study of Animal productions, by observing the processes of local growth, and the reparation of damages in their most permanent solids, I now venture to draw a line of distinction between organic parts constantly amenable to the vital domination, and parts which are either wholly or in some degree

extraneous to the vascular and nervous systems. I might expect to extend this doctrine with more success, if the present occasion had afforded opportunity for adducing all the comparative evidences of my past experience;—but several conclusive experiments, made upon living Oysters at Faversham by Mr. GIRAUD, may suffice to establish the extra-vascular formation of Oysters' shells.

During the Summer and Autumn of 1825, Mr. GIRAUD conducted numerous experiments, at my suggestion, upon Oysters, in one of the Oyster-beds at Faversham. They were confined in suitable cages, and a buoy-rope enabled him to inspect them at pleasure. Many important details have resulted from these accurate experiments; but, as their prolixity is unsuited to this Discourse, I shall deposit his Letters in the Archives of THE MUSEUM, together with his Specimens.

It appears that the Oyster has a discretionary power to repair breaches in it's shells, to stop holes drilled through them in any part, or to coat extraneous objects when obtruded between it's valves,—and that the animal begins to fence it's tender body as soon as any breach occurs in it's shells, by spreading a film of insoluble membrane over the damaged surfaces. In no instance is there any exudation from the bored or broken edges, whether they are of recent or of old date; and it also invariably happens, that the films of repairing membrane are confined to the inner surfaces of the shells, and they adhere solely to parts opposed to or contiguous with the living body.

From a wish to ascertain what the Oyster would do, after a total division of it's elastic ligament at the hinge, Mr.

GIRAUD was desired to cut the ligament through, without injuring the animal,—and it appears, from several trials, that a membranous screen was immediately formed, so as to exclude any entrance by the hinge into the cavity of the shells,—the Oyster continuing to live for many days without apparent inconvenience; but no effort was made to restore the elastic ligament,—indeed, the membranous screen, formed for immediate security, prevented the contact between the living secreting surfaces and the damaged parts.

All the valuable facts ascertained by Mr. GIRAUD correspond with the manner of growth and of reparation in other shells,—while they exhibit direct proofs of coherence between the self-modelling, organized structures of living parts, and extra-vascular deposits.

Many shells are liable to borings from predatory worms and other creatures, and some of the larger and more durable kinds of shells are penetrated by other testaceous animals; but none of these bored surfaces are ever filled by exudation from the shell itself,—for the repair or stopping is never attempted, unless the invader penetrates the domicile, and then a plaster or plug of albumen and carbonate of lime is thrown out from the opposite surface of the living animal. A close contact between the living parts and the surface where new shell is to be deposited, seems to be the first step; but whether this be done merely to exclude external things, or to adapt the forming plate to its shape and thickness, is not obvious.

Every portion of the external membrane of the Oyster is capable of making shell, under any of its combinations,—as may be seen at the borings, augmentations, and repa-

ration of these shells in every part; so that neither any especial organ, nor any particular instrument, is appointed for the secretion of the materials of shells.

When Oysters are dredged from their natural situations, and placed in beds more favourable to feeding, they rapidly augment the circumference of their shells, even to the extent of an inch during the first two months,—but in such cases the concavity within the valves is shallow; while Oysters bred in places where food is most abundant, have their shelly concavities deeper, and their valves of a more equable thickness and form.

When the Oyster animal becomes reduced in bulk, and it's body does not fill the hollow in the concave valve, sea-water passes into the vacant space, and the creature immediately covers it with a dome of thin *Naker*. The water thus inclosed afterwards yields sulphureted Hydrogen gas,—and it appears often to remain in those cells for many years. Other occasional vacancies within the valves, situate between the valvular muscle and the margins of both shells, are generally filled with patches of Carbonate of Lime, free from membranous films. From these and similar evidences it appears, that the Oyster exercises a discretion in producing the materials for augmenting, repairing, and adapting it's shells,—and also, that it selects the appropriate materials for each occasion.

The natural history of organic substances is necessarily perplexed,—because the compounds being ordered for temporary purposes, they chiefly consist of elementary materials in a gross state of *mixture*; and while these materials continue parts of living fabricks, they are subjected to various changes.

The primary element of all organic compounds, *the blood*, undergoes continual changes from the secretions and excretions, each of them altering the proportions of its constituent materials; while the more solid and more durable substances, which are under the control of the vascular system, are undergoing renovations after decays or waste, repairs of damages, or augmentation.

Unquestionably, the governing and directing powers which order all the offices of living creatures, are distinct from the laws of inanimate bodies; but I am anxious to show, that the concurrence of vital and physical causes is not incompatible,—and that they act together in living structures, reciprocally affecting each other's products,—rendering the several parts of our bodies more or less amenable to the agencies of life, and to those of unorganized matter. This doctrine may perhaps be tolerated by those who bear in mind the intimate connection of physical causes with all the ministrations of the Healing Art,—and who also reflect, that the surest reasonings upon the manner in which our remedies act, are those which best accord with the known affections of inanimate matter. Under the ill-defined and the supposed exclusive domination of Life, our systems of Physiology and Pathology remain little better than *Mysteries*, illogically constructed, and often contrary to the inductions of Science; for the nature and qualities of Life are so blended with organized matter, and the changeable materials of animals are so differently circumstanced in many compounds, that Naturalists cannot arrange their truly fixed mineral compounds with the transitory mixtures peculiar to living vascular parts,—and hence it becomes more philosophical to consider them separately.

If the raw materials of animal and vegetable sustenance had obviously contained the simple elements of all organic formations, it would have been more easy to account for the products elaborated by living structures; but since it is otherwise, the best method for improving this part of Physiology appears to be,—that of beginning with the examination of those fixed compounds, which either belong to the mineral kingdom,—such as the calcareous portions of shells, teeth, and bones,—or, those exuvial productions which clothe and protect sensitive parts,—as our cuticle, nails, and hair, and the varied apparel of birds, beasts, reptiles, fishes, and insects.

The shells of the eatable OYSTER exhibit examples of both mineral and animal extraneous deposits. The gross proportions of those two kinds of material were found, from an average of trials, to be, twenty parts of carbonate of lime, to one part of animal albuminous membrane; but this analysis is taken from the whole of the shells,—and, as I before stated, the different parts of the shells vary in composition, and even the same shells under some circumstances possess a greater or lesser proportion of mineral matter.

In a pair of fresh Oysters' shells, weighing 3488 grains, the entire elastic ligament or spring of the hinge weighed three grains and a half; the elastic power of this spring was equal to the pressure of three pounds fifteen ounces avoirdupois, when placed upon the centre of the flat valve, and confined to the area of the insertion of the valvular muscle.

There is one general fact respecting the composition of bones, teeth, and shells, which may prove available in the future advances of Physiological science: it is, the occurrence of *animal gelatine*, where the earthy solid proves to

be phosphate of lime,—and the occurrence of *albumen*, where carbonate of lime forms the hardening material.—These general coincidences seem to indicate some intimate connection between those animal and mineral products; but chymical knowledge is not yet equal to show the origin of any of the *earths*,—or to demonstrate the conversion of *albumen* into *gelatine*, or *vice versa*,—events, which seem to be readily effected by organic elaborations.

The immense beds of calcareous corals in the Pacific Ocean cannot have derived their lime from the sea-water under it's present composition,—and there is no reason for considering the *coral polyps* less active now than at any former time.

During the incubation of the eggs of birds much of the *albumen* disappears, and *gelatine*, in proportions not before existing, is to be found in the chick; it also seems, that the *sulphur*, so abundant in the original albumen of the egg, is changed into *phosphoric acid* by the organic processes, during incubation.

Perhaps Physiologists have proceeded in error, when they sought for the explanation of those seeming transmutations, by tracing the minute vessels of glands; and again, more recently, in ascribing them to electrical agencies; since the chymical powers of electricity have been discovered, and since electrical batteries have been found in the nervous systems of the *Torpedo* and *Gymnotus*; but the latter hypothesis fails, when we consider the chymical elaborations of vegetables to be entirely free from brain or nerves.

Much logical confusion prevails in the language of Medical Physiology, from a slovenly use of terms: Anatomists

being in the habit of employing the word *infinite*, when they can only mean *indefinite*; thus, in speaking of the extension of tubular vessels, it is often assumed that they are *infinitely* subdivided,—a position which is physically absurd. The tubular vessels of animals are, in all cases, merely the gross conduits of supply; and their proportion to the parts, their forms of ramification, and even their ultimate smallness, are subordinate accommodations.

The anastomosing continuity between the arteries and veins at the extremities of the human fingers, freely admits the passage of quicksilver; but the terminal branches, which carry the materials for growth, replenishment, or secretion, are impervious to our injections, and also *generally* to the red particles of blood. The several peculiarities in the distribution of minute vessels in *glands*, appear to be solely adapted to retard or to accelerate the flow of the elementary liquid, from whence the secretion is to be derived; indeed, the structure of all vegetables, and the scantiness of vessels in many simple animals, show that there is not any *necessary* connection between tubular vessels and organic secretions, of the most remarkable kind; while the notion of secretory changes effected in continuous tubes carrying fluids in a circle, leaves no opportunity for augmentations or deposits, beyond the confines or cavities of those vessels.

Persons, unacquainted with the purposes of Mr. HUNTER's Collection, have complained, that it is deficient as to illustrations of Human structure; but they should recollect, that He was not an Anatomical Schoolmaster,—his Works were directed to establish a general system of Organic

Philosophy, and to form a series of Physiological and Pathological evidences, which were designed to comprehend ALL NATURE;—and this GREAT DEPOSITORY of ZOOLOGY and of ZOOTOMY cannot be otherwise properly employed.

Having stated that the exterior of the living Oyster does not exhibit any especial *gland-like* structure, and that the creature possesses a capability to form shell at every surface, I am thence led to conclude, that the modes of depositing both the animal and the mineral portions of their shells are mere exudations, governed by the discretion of the living animal.

A question of great importance arises out of the consideration of chymical changes effected in living bodies,—for, by a reasonable license, all the growths and reparations of parts, as well as the secretions, and even muscular contraction, may be ascribed to the agency of vital powers, whose manner of operating is like some of the artificial processes of chymistry. When, however, the transitory mixtures, and the temporary compounds of animal or vegetable elaboration, are subjected to the destroying effects of fire, these peculiar properties, which had been ordained for the uses of living creatures, are totally lost. The formative processes of life are all conducted (according to chymical phraseology) in the moist way; and, I apprehend, that their nearest artificial imitations, whether they be analytical or synthetic, will be those which most closely resemble the natural workings of organic structures.

An interesting discovery of this kind was lately made by Mr. BERZELIUS, who, from a slow maceration of *Starch* in diluted Sulphuric Acid, has actually produced *Sugar*,—a

vegetable substance, heretofore considered to be of organic secretion. This extraordinary discovery seems to show the way to many others in our Physiological Chymistry.

The remarkable changes effected upon the crude materials of animal and vegetable *sustenance*, may be regarded as the products of *Organic* Chymistry,—a power which unites the mysterious agency of life with the better known agencies which govern inanimate matter.

Mr. HUNTER has, with his usual rare acuteness and accuracy, shown the manner of depositing the *Enamel of Teeth*,—and he remarks, that it is always conducted within a membranous case or inclosure, where the lime is abstracted from a liquid, and then attached to the bone of the tooth in a crystallized state,—but he doubts the possibility of advancing the inquiry any further. I have, however, ventured to think, that the present state of natural knowledge, aided by chymistry, is adequate to advance this inquiry several stages higher.

The calcareous crust of a bird's egg is formed under similar circumstances to the enamel of teeth, and to the enamel-like auditory bones of fishes,—they each consist of crystallized prisms placed in radii, forming regular secants to the curved surfaces on which they are fixed,—and the crystallizations of each are slowly effected in a watery medium, and within especial inclosures. A similar order of proceeding also obtains, when local repairs or augmentations happen to the shells of Oysters.

The eggs of domestic pullets often exhibit a cluster of equal-sized calcareous spherules adhering to some part of the previously finished shells, and these spherules mark two

important facts,—first, the size of the maternal vessels, from whose openings the minute drops of concentrated calcareous solution had issued,—and, secondly, that the *precipitant* of the lime was contained in the ambient liquid, which is interposed between the putaminous membrane of the egg and the uterine surfaces.

I have deposited in THE MUSEUM of THIS COLLEGE, an extensive collection of Crustaceous and Testaceous Specimens, to illustrate and prove the doctrines now advanced; and, I trust, they will be found sufficient to establish this attempted addition to organic Physiology and Pathology.

The manner of growth and the final structure of the internal bones of man show, that their calcareous portions have not been deposited within arborescing vessels,—as the linear directions of the calcareous deposits in the bones of the skull, and in the shafts of the limbs, unequivocally prove.

The modelling of vascular bones is principally governed by the direction of the fibrous structure of the animal gelatine; an organic formation, which must have existed before the solution of lime had been presented to the phosphoric *precipitant* within the *interstices* of the gelatine,—else the vessels conveying the lime would have been choked up, and their solidified arborescing tubes would have remained to announce the circumstance.

The organic portions of the human teeth were, in their first stage, vascular gelatinous pulps, into which mass the concretable lime is infiltrated, and it gradually fills their interstices. This exception to fibrous texture, in the animal basis of teeth, has a parallel in the petrous or auditory

portions of the temporal bones. When the structure of human teeth is completed, their exposed surfaces are coated with inorganic crystallized enamel, which does not possess either the vascular animal basis of bones, their capacity for sensation, or capability of self-repair. Damages to the protecting enamel of teeth expose the organic vascular bone, which then falls into a state of disease, called "*Inflammation*;" acquiring sensibility, apparently from increased vascular connections with the living system, and hence it decays like other exposed bones.

From regarding the chief causes of decay in teeth to be the corrosive action of substances externally applied to them, and that attacks of the tooth-ache are generally produced by the temporary effects of acrimonious things, such as saccharine and sharply acid fruits, we obtain the indications for preserving our teeth, and for avoiding the ordinary causes of tooth-ache. That denuding erosion which often affects the necks of teeth when the external periosteum and gums recede, may be abated by frequent ablutions of lime-water, after careful picking and brushing.

In the plastic operation of making extra-vital shells, the work is differently conducted from that of vascular modelling,—and the extravasations of both calcareous solutions and of solidifiable albumen, are *released* from the *dominion* of life when they quit the vascular system; hence it is, that shells do not possess the capability of self-repair, like bones,—neither do their albuminous membranes show any fibrous or reticular structure; while the carbonate of lime, undisturbed by the vascular and vital *commotions*, falls (under mineral affinities) into a state of imperfect crystallization.

The source from whence the lime of shells and bones is obtained, still remains unknown; but from two experiments made upon living Oysters, confined in a given quantity of sea water, it appeared to me, that the proportion of muriate of soda was daily diminished,—and when we add the fact of the notorious thickness of marine shells beyond those of fresh water, it becomes worthy of inquiry, *Whether the soda may not be convertible into lime?*

Numerous and various evidences, arising from observing the structure and the offices of animal and vegetable organization, and which I have for more than twenty years occasionally communicated to scientific men, have led me to consider the most remarkable changes effected upon matter by living bodies, as far more potent and more extensive than the narrow scope of our science.

If, however, the cultivators of Natural knowledge do in any instance, either by any series of observations, or by the inquiries of experiments, detect the manner of change or of seeming transmutation, which is so common and so facile in the functions of living animals and vegetables,—they will supply more rational views to the Healing Art, and contribute to remove those oscillations in opinion and in practice, which disgrace the Profession.

SURGEONS possess the great advantage of *seeing* those different kinds of outward diseases or injuries, which are only known by circumstantial evidence when concealed *within* the body; and SURGEONS have the best opportunities for judging of the good or harm of their ministrations, because they can inspect the damaged parts at discretion, during every stage of malady and its treatment.

The promotion and the diffusion of general Zootomy by THIS COLLEGE, is of the highest public utility,—and I have no doubt of the superior value of confronting the various facts of COMPARATIVE ANATOMY, for establishing clear and simple doctrines in organic Physiology, above the endless and often frivolous minutiae of the human structure; but ANATOMY, even when carried to it's widest extent, is not sufficient to explain *any* of the chymical functions of living bodies.

Fastidious dissections, and microscopic displays of vessels, may show the limits of continuity, and the several communications among organized structures; but such views are merely topographic, and only exhibit the gross mechanical framework of a living creature.*

We now require a corresponding advancement in the knowledge of the respective influences, which different kinds of organic substances exert upon each other, in order to elucidate the physical causes of secretion, of assimilation, and of particular deposits of especial matter,—all of which appear to belong to organic chymistry.

The tubular vessels of animals are but gross conduits of supply, and nothing analogous occurs in the vegetable structures; yet, the chymical changes effected in each kingdom, are equally remarkable, and even more diversified in

* A beautiful series of vegetable leaves, deprived of their membranous and parenchymatous parts, have been lately added to THE MUSEUM. The endless variety in the modes of the lace-work exhibited in the woody fibres which constitute the skeleton or solid frame-work of these leaves, affords a striking exemplification of the equally unimportant diversities which occur in the distribution of the minute vessels and fibres of animals.

vegetables. Our researches must, therefore, be carried beyond the tracings of vessels and the connections of fibres, before we can approach the causes which influence organic and vital elaborations. It is obvious, that, while the restorative fluids of animals and vegetables are flowing through tubes, or continue to move within reticular or cellular tissues, the appropriate materials for growth, renewal, or repair, can neither be compounded nor selected; but, as every solid part has it's peculiar parenchyma, in addition to it's vessels and fibres, we must look to the constitution of that substance as a potent auxiliary in all organic formations.*

These varied parenchymatous compounds pervade all organized structures, extending from the *Tuber* of the *Potato*, up to the medullary substance of the *Human Brain*. They constitute the entire mass of some apparently homogeneous animals and vegetables,—such as the *Medusæ*, and the *Tremella nostoc*; and they form the principal bulk of many organs in complicated animals.

A more exact inquiry into the respective offices of vessels, and of these differently compounded parenchymatous deposits, must advance the knowledge of vital operations; while the contemplation of extra-vascular parts, holding a dependence upon the preserving agencies of life, will importantly aid in explaining the tenure of existence bestowed upon many passive substances, whose mineral condition, or want of self-replenishing vessels, gives them an equivocal character.

Both in the states of Health and of Disease, we observe many extravasated liquids and solids within the human body,

* The state of comparative rest assigned to this material, is an interesting fact.

or attached to parts of it, which resist spontaneous decomposition far beyond their physical capacities when removed from the living influence. Instances of this sort occur in the solid detached substances produced by disease within the knee joint,—in the cataract of the eye, which is the *death* of the crystalline lens, following the loss of it's *single* supporting artery,—in dropsical deposits, which remain uncorrupted for many years,—and in those concentric flakes of coagulated lymph, which form the bodies, called “*Globular Hydatids.*”

A more profound acquaintance with these highly interesting phenomena, and a better knowledge of the manner in which medicinal substances act upon living matter, must tend to *rectify* the doctrines of Pathology and of Therapeutics,—give the Healing Art a just claim to the rank of a Science,—assure the confidence of enlightened men,—and afford incalculable advantages in our Practice.

HONOURED PRESIDENT,

I have considered it inexpedient to quote from any of the learned or ingenious Authors who have written upon the structure and physiology of Testaceous Animals,—because, to do justice to such Works, I should have been compelled to occupy the full time allotted to a single Discourse.

Finally, it devolves upon me to speak of our deservedly lamented Colleague, Sir DAVID DUNDAS, who died on the 10th day of January last, at the venerable age of 77 years.

This honoured Gentleman became a Member of the ruling body of THIS COLLEGE in the year 1791, as a consequence of being appointed by our late Sovereign to be one of His SERJEANT SURGEONS; and His present Majesty,

whose gracious patronage of the Healing Art surpasses that of all former Kings, created him a Baronet in the year 1814.

During a residence of fifty-six years at Richmond, in Surrey, Sir DAVID DUNDAS was constantly engaged in the joint duties of a Surgeon and Physician. To a benevolent nature he united a manly firmness, graced by modesty, urbanity, and charity.

In the various and highest offices of this College, his conduct was always distinguished by ability, integrity, candour, and good manners. He was a classical and a professional Scholar,—and his scientific attainments were rendered applicable to practice by extensive medical knowledge, derived from experience.

The Profession have sustained a great loss by the death of this virtuous public man; for in every Institution where power is to be exercised, there will be strong temptations among the least worthy, to grasp a brief authority, and to pervert the most sacred public obligations to the narrow ends of vanity or selfishness,—verifying the wise words of the Poet,

“And Fools rush in, where Angels fear to tread.”

THE END.

Printed by WILLIAM NICOL,
Shakspeare Press,
Cleveland Row, St. James's, London.

